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EDITORIAL NOTES

THE PRODUCER GAS SCHEME

IT is just over two years since the Minister of War Transport decided upon action to equip, "as soon as practicable," 10,000 commercial vehicles with the Government emergency producer, the aim being to save something like 100,000 tons of imported petrol, and to this extent ease the heavy strain on shipping which at the time obtained. We reviewed the whole situation at some length in the "JOURNAL" of Aug. 5, 1942, when we mentioned that at that date two types of producer plant had been decided on—that of the Government and that developed by Tillings. Much has happened since 1942 and the war situation has undergone marked change—such a transformation, in fact, that the Minister of War Transport announced last week that the producer gas scheme can be closed down, and that operators of goods or passenger vehicles can, if they wish, revert to liquid fuel operation. We imagine that such reversion will be made without delay. Coincident with the announcement is the pressure being put on vehicle operators in Germany to use more producer gas and less liquid fuel, all of which is very heartening. In Germany, of course, conversion to producer gas traction has been on a wholesale scale through *force majeure*, and we might add that, apart from the exigencies of war, conditions in Germany regarding fuel are not comparable with those in our own country—a point which invalidates generalizations.

The fact that our own scheme is now "closed down" does not mean to say that technically and nationally it has not been a successful enterprise. "Fortunately," said the Minister, "a large-scale conversion to producer gas has proved unnecessary, but had the need arisen the experience gained in producer gas operation would have been invaluable for the continuance of the national war effort." We would strongly underline this, while expressing the hope that development work on improvement of both plant and fuel will be continued. We hope also that before long it will be possible to tell the story in detail of what experience has been gained in the past two years during which the scheme has been in operation, for essentially the story will be of direct interest to the Gas Industry as a potential supplier of a very large quantity of fuel for mobile producer gas plant. "Potential" is, we think, the right word to use, for in point of fact the scheme envisaged, small as it was in scope—*i.e.*, 10,000 vehicles—was far from fully put into operation. The reasons for what may appear at first sight a meagre show are not hard to find, and the underlying reason is the proper balancing of conflicting factors in the determination of the best policy in furtherance of the war effort, in furtherance of national interest. The problems of labour, raw materials for equipment, life of vehicle, operational efficiency, and availability of fuel for the purpose must be considered, and, in a nutshell, in the light of "is it really necessary?" and bearing in mind other vital calls on labour and materials. All this, during wartime, apart from economic considerations.

Two years ago, when the producer gas scheme was launched with Government approval—indeed, with Government insistence—we queried in these columns whether the Gas Industry was in a position to supply at short notice suitable fuel for mobile gas producers. Experience has shown that—granted the supply of the right type of coal—the Industry could in fact meet the need wholly satisfactorily. Plans were quickly drawn up to cope with an emergency situation which, in the outcome, did not materialize. If the Industry had been called upon to deal with the added demand it would not have been found wanting, and we would say once again that the impetus given by the Government's decision two years ago has been immensely useful. Most valuable experience has been gained in design and general operation of plant, in discovering and surmounting difficulties, and in the supply of fuel conforming to rigid specification—for mobile gas producers are fastidious in their appetite. Fuel supplies, consisting of anthracite and high-temperature coke, would not have constituted a difficulty, and coke alone, it was estimated, would be capable of supplanting an amount of petrol far beyond that envisaged when the scheme was embarked upon. But there are other factors, as we have said, and the designation "emergency" producer was perhaps an appropriate one. Producer gas plants for motor traction are clumsy affairs, and they call for more labour than does petrol. For its bulk petrol has a high thermal capacity; it is a "concentrated therm" as it were; it is easy to handle and to store; and transport has been developed on it—which point is reason why we should continue rather than cease experimental work on producer gas. By comparison—and we are talking not in terms of emergency conditions—the storage and cartage of solid fuel do not show to advantage, and we are doubtful about any advantage in over-all cost. Though maybe to be deplored, it is not surprising that every possible excuse has been put forward to avoid conversion from petrol to producer gas. However, had there been real emergency, excuses would have gone by the board, and the organization actually brought into being would have been capable of meeting demands much greater than those originally contemplated. The Coal Survey of the D.S.I.R. proved its usefulness yet again; the country was divided up into "supply areas"; and gas-works for the production of coke for producer gas had been selected. We also had the Royal Navy.

There is no doubt about it that, with selected coals carbonized in suitable plant, producer gas fuel can be made without difficulty. Had the spur for production been used instead of being merely ready, we think the Gas Industry would have benefited, for we have not carried out enough practical, as distinct from laboratory, work on the manufacture of reactive cokes for use not just in mobile producer plant but in the wide sphere of domestic application. We appreciate that our first aim must be to maintain continuity in gas supply, and we can be rightly proud of our achievement in this direction. The war record of the Gas Industry is the reverse of mean. As example, during the flying-bomb period, apart from damage to gasholders, 750 gas mains were affected, in the speedy repair of which gas undertakings did "a gigantic job amazingly well." We quote the Minister of Fuel and Power in a speech at Bristol last Thursday. While, however, we maintain this continuity, we should devote more extensive effort to improvement in the products other than gas which we offer; and reactive coke ought to be a major product. And if in peacetime, while ample sources of natural fuel oil exist, producer gas for transport is not attractive—and we are not going into any detailed argument about this—we must lay ourselves out to be capable of producing liquid fuels in concentrated form from coal and coke, as and when required and in whatever quantity.

A chapter, then, on producer-gas motor propulsion has been written, and the Government scheme has come to an end. But the book has not by any means been finished. Further chapters remain to be prepared. While awaiting their completion we hope that the first instalment—perhaps with some such title as "mobile producer gas plants in wartime"—will be made public. We could think of many an appropriate platform for a Paper on the subject, among these platforms being the I.G.E.

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SMALLER MUNICIPAL UNDERTAKINGS

ON a later page will be found further observations on the future of the Gas Industry by the Association of Smaller Municipal Gas Undertakings. These observations are in support of the Association's report published at the close of last year, and they have been submitted to the Ministry of Fuel and Power. It is, of course, right that the voice of the smaller undertaking, municipal or private, should be heard, though it is at first glance somewhat difficult to assess to what extent the observations do in fact give the Minister a lead. As was to be expected, the bias is on more municipalization, the argument being used that transfer of municipal undertakings to private ownership would create considerable opposition from the general public. For our part we think that the public is in general quite unconcerned as to the ownership of the Industry, but wholly concerned regarding the service which can be given—it is a question of the end and not the means. The giving of this service is hedged about with regulations all aimed at safeguarding the consumer, and for the success of any gas undertaking consumer interest must be put first—and this irrespective of ownership. Also, there must be incentive towards this end, and no doubt a regulated profit motive does provide legitimate incentive, though we are not surprised to note that the Association does not consider total private ownership in the best interest of the Industry. Efficiency, too, the Association maintains, is not necessarily dependent on size, and this, up to a point, is substantially true. But only up to a point. A large gas-making unit efficiently run can be regarded as a series of small gas-making units efficiently run; but on the one aspect of gas-making there would appear to be a limiting size below which adequate technical control becomes difficult or impossible. And gas-making is only one phase in the all-round administration, technical and commercial, of a gas undertaking. The Association, in its observations, recognizes the need for integration, and in this respect we think it will be agreed that what integration has so far been effected has been chiefly the achievement of private enterprise. "Experience has shown"—we quote from the report—"that integration has been taking place over a very long period of years by mutual consent, and [the Association] therefore submits that no other system is required to deal with the natural evolution of the Industry." It seems doubtful to us, however, whether integration on orderly lines will be effected to the extent which is very widely deemed desirable unless some element of compulsion, or at least regulation, can be introduced. Also on this question of integration the Association strongly opposes the methods proposed by the British Gas Federation in its report on the ground that such methods are unconstitutional and would be a "retrograde step," and that no absorption or amalgamation should be permitted without prior sanction of the Minister of Fuel and Power. At the same time, the Association does not favour nationalization "unless and until it is applied to industry as a whole," and regards it as desirable that political view and opinion should not confuse the issue—a desirability which we have stressed many times.

On the whole, even if we do not regard the report as solving any of the Industry's major problems, we like the general tone of it, the tacit recognition of the fact that evolution in this case is more likely to serve the public than revolution, and the current of live-and-let-live thought that runs through it. There is no basic quarrel with private ownership for its own sake, which is a welcome concession from an Association composed entirely of municipally owned concerns, and which offers every hope that its members will be ready to co-operate in furthering any scheme, even if it is not of their own fashioning, which appears likely to benefit the Industry.

American Gas Industry in War

The vital part the American Gas Industry is playing in the "greatest public effort that has ever been organized and maintained in the States" is the subject of a recent article by the President of the American Gas Association, Mr. Ernest R. Acker. In it he says the current high operating rate of the Industry shows the tremendous effect of the war. At present the Industry is serving the largest number of customers in its history—a total of more than 19,400,000. Sales of gas for industrial and commercial purposes, in which category wartime use of gas is reflected, showed an increase in 1943 of 53.6% over 1939, which was the last year before the defence-programme took effect. This tremendous amount of additional business was handled with fewer employees and with very slight gain in capital investment—indicating that little in the way of critical and strategic war materials was used to enlarge the Gas Industry's productive and distributing capacity. While total investment remained relatively stable, sales of gas per employee rose from 12,740,000 cu.ft. in 1939 to 18,111,000 cu.ft. in 1942, an increase of 42.2%. Gas Industry employees during this period dropped from 132,700 to 121,922, a decrease of 8.1%.

He continued: "Although the Gas Industry is highly integrated, it is nevertheless a complex undertaking with characteristics peculiarly its own. It cannot be advantageously considered as a whole without recognizing that it is a production business, a manufacturing business, a transportation business, a distribution business, a collection business, a mercantile business, a development business, and, finally, a business regulated in the public interest. Consequently, its war task has been great and has touched virtually every field of human endeavour. The soundness and adaptability of the Gas Industry have never been more clearly demonstrated than during the past few years, when it has met every requirement of the war emergency without serious curtailment of supply for war production or essential civilian services. It has also made many collateral contributions to the war programme. This performance is the result of able and resourceful management as well as effective co-operation with governmental authorities."

Personal

Mr. OSWALD E. LONGDEN, for the past three and a half years Assistant Engineer and Manager to the Stirling Gas Light Company, Ltd., has been appointed General Manager of the Armadale group of undertakings owned by the Caledonian Gas Corporation. He was formerly Assistant Engineer and Manager to the Musselburgh Gas Company.

Diary

Sept. 27.—Industrial Gas Centres Committee, Birmingham Gas Department, Council House, Birmingham, 11.30 a.m.
Sept. 28.—Wales and Monmouthshire Association of Gas Engineers and Managers: General Meeting, Institute of Engineers, Park Place, Cardiff, 11 a.m.
Oct. 6.—Junior Institution of Engineers: Informal Meeting, 39, Victoria Street, S.W. 1, 6.30 p.m.
Oct. 7.—Yorkshire Junior Gas Association: Annual Meeting, Great Northern Hotel, Leeds, 2,30 p.m.
Oct. 11.—Southern Association of Gas Engineers and Managers: General Committee, 11.30 a.m.; Autumn Meeting, 2.30 p.m.; Grosvenor House, Park Lane, London.
Oct. 12.—B.G.F. Domestic Heat Services Committee, Gas Industry House, 2.30 p.m.
Oct. 12.—Institute of Fuel: Annual Luncheon, Connaught Rooms, 1 p.m. Presidential Address by Dr. E. W. Smith, C.B.E., followed by Melchett Lecture by Dr. J. G. King, O.B.E., 2.15 p.m.
Oct. 27.—Manchester District Association of Gas Engineers: Autumn General Meeting.

A Surplus on Revenue Account of £53,179 for the half-year to June 30, compared with £70,620 for the corresponding period of 1943, is reported by the Alliance and Dublin Consumers' Gas Company. A dividend at the rate of 2% per annum (1% actual), less tax, the same as last year, is recommended, leaving £12,126 to be carried forward.

The Annual Luncheon of the Institute of Fuel will be held at the Connaught Rooms, Great Queen Street, W.C. 1, on Oct. 12, at 12.30 for 1 p.m. Lord Woolton will be the principal guest. An address by the President, Dr. E. W. Smith, C.B.E., will be given at 2.15, followed by the Melchett Lecture by Dr. J. G. King, O.B.E.

A Meeting of the East Midland Section of the Institute of Fuel will be held in the Lecture Theatre of the Nottingham Corporation Gas Department, Parliament Street, Nottingham, at 3 p.m. on Oct. 19, when the President of the Institute, Dr. E. W. Smith, C.B.E., and Mr. Theodore Turner, K.C., Regional Fuel and Power Controller, will speak at a Conversazione.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

North British Association of Gas Managers

THE Annual Meeting of the North British Association of Gas Managers was held in the Freemasons' Hall, Edinburgh, on Sept. 8, Mr. Robert Fife, Kilmarnock, the President, in the Chair.

Welcoming the large company, Mr. Fife said they had been disappointed at the cancellation of the Institution meeting, especially as their friend Mr. Jamieson was the President. However, the output of technical Papers and administrative material from the Institution had continued unabated. Since their last meeting, said the President, they had lost by death Messrs. Alexander Dow, late of Galashiels; Alexander Mackay, of Motherwell and Stoke-on-Trent; and William Wilson, of Falkirk and Burton-on-Trent.

In the absence of Mr. S. E. Whitehead, President of the Institution, Mr. J. Jamieson, Edinburgh, Past-President, conveyed the good wishes of the Institution for a successful meeting.

The Annual Report was adopted, and it was intimated that Messrs. Andrew Sutherland, Dalmarnock, Glasgow, and O. T. Longden, Armadale, had joined as Ordinary Members, with Messrs. E. Cawood (George Bray and Co., Ltd., Leeds), S. C. Thomson (Clayton, Sons & Co., Ltd., Leeds), and J. I. Ferns (Charles Ferns & Co., Glasgow), had joined as Extraordinary Members.

It was agreed that the annual subscription be raised by five shillings as from July, 1945.

Mr. **H. S. Milne** then read his Paper entitled "Converting the Unbeliever—Some Aspects of Gas Utilization." This was published in last week's "JOURNAL."

Discussion on Mr. Milne's Paper

Mr. **Fife** said that overhead heating was one of the most useful forms of heat introduced in recent years. He had tried it out in a public library in Kilmarnock, the cost being reduced by 90%.

Mr. **R. D. Keillor** (Greenock) said the material in the Paper should be studied both by members and by the Committee of Enquiry now sitting. Mr. Milne had shown that gas could do the job at 50% of the cost of oil, and there was no reason why gas should not replace oil for heating. Millions of pounds were being spent in Scotland on electricity, and he felt something should be done for gas so that it might be made available at a low figure for everybody.

Mr. **J. M. Dow** (Kirkcaldy) said the Paper was typically Aberdonian. It contained a mass of dehydrated information concentrated into small form. Mr. Milne said instantaneous water heaters were not satisfactory in Aberdeen for reasons given in the Paper. In Kirkcaldy also they had wide water pressure fluctuations. In many cases they fed direct from the tank, thus overcoming the problem and getting the water at a standard pressure to the heater.

Mr. **A. Bujnowski** (Glasgow) said he had seen the Aberdeen installations and they reflected the greatest credit on Mr. Milne. The price of fuel was not the only criterion. He would like to know the efficiency of the boilers and the type of oil used. Mr. Milne had explored the possibilities of overhead heating and it had a great future. Gas would be faced with even more severe competition, and he hoped the Industry realized the need for good technical salesmen.

Mr. **W. Nicol Baird** (Perth) said they had been more fortunate in Perth in being able to use instantaneous water heaters, and it was a pity that any undertaking should be unable to use such fine appliances.

Mr. **David Fulton** (Helensburgh) said that members wishing more details should apply to the Industrial Centre at Glasgow, which existed to receive and collate all information.

Mr. **A. J. Cousins** (Assistant Secretary to the Ministry of Fuel and Power) said the electrical industry was highly organized on a nation-wide basis and the same should apply to the Gas Industry. The day of cheap coal, had gone, and the Industry had to contribute to finding something to take its place. Advisory Boards had been helpful to small undertakings, but the task of the managers there was very difficult. If they were inclined to think the Ministry was not always helpful, they should remember that however much they sympathized with applications for extensions they were limited by the material available. The Ministry itself worked under difficulties.

Mr. **W. A. Currie** then read his Paper—see last week's "JOURNAL" and p. 375.

Discussion on Mr. Currie's Paper

The **President** said that at first glance the Paper seemed complicated, but the methods it described were simple in actual practice.

Mr. **E. G. Smith** (Dunfermline) said that in small works it was easier to examine costs in detail, and he hoped that if integration came in Scotland they would leave one small works where costs might truly be ascertained. An estimate was an opinion, price was a policy, but cost was a fact. In connexion with the varieties of gas produced, did Mr. Currie always bear in mind the specific gravity and composition in the mixtures?

Mr. **J. Webster** (Lockerbie) said, regarding variable amounts, Mr. Currie could level his bunkers and correct his stock by measurement. The charts were, he thought, too complicated.

Mr. **D. D. Melvin** (Edinburgh) remarked that Mr. Currie had given a Paper which provoked thought and comparison. One was always anxious to get the simplest and best methods of observing and assimilating working results, costs, and plant operation strategy, and this Paper was most helpful. In connexion with the method of evaluating gas-making results, the simple suggestion seems to be to level the coal bunkers weekly at a predetermined time and so make the major adjustment which seemed to make so much difference to the weekly results. He was not too clear on the "plant efficiency" figures. They appeared to be really "coal efficiency" figures, particularly at present, when coal deliveries varied so much in quality—even the name on the wagon ticket being little guide to the contents. He noted from the Paper that "although the proportion of Tully gas to vertical gas varies between *nil* and 50% we have no effect on the gas quality visible to the consumer." Were there any effects visible to the management? Perhaps Mr. Currie would let them have the specific gravity of the two gases and the maximum variation in this property in the gas supplied. Did the gas quality comply with the recommendation of the Institution Committee of Enquiry on Gas Quality? The cost figures for supplying various mixtures of gas apparently only legislated for the production of sufficient gas to satisfy the requirements of the area. No provision was made for the coke consumer, nor were the effects of making sufficient coke to satisfy the coke market shown, and it would appear that the output of coke when the price of oil rose over £4 would be increased eightfold. In the post-war periods it would appear that the strategy to be employed should be one of regulating the coke output to meet the demand, and the regulated use of complete gasification plants and blue and C.W.G. plants seems to be the best method to employ, if gas quality was not affected.

Mr. **David Fulton** (Helensburgh) said the Paper had shown them how to examine their work more carefully.

Mr. **Currie,** replying, said that his hoppers were levelled each Friday—if they had any coal. Regarding the visible effect, the consumer got increased illumination from mantles.

Mr. **R. M. Simpson** (Denny), as Past-President, handed Mr. Fife a souvenir Presidential badge, expressing the thanks of the members for his services as President. Mr. Fife acknowledged the gift, and Mr. Sturrock, Secretary, responded to a general vote of thanks proposed by Mr. Ritchie (Falkirk).

Luncheon Speeches

Councillor **Adam Millar,** Edinburgh, presided at the civic luncheon.

Principal **J. Cameron Smail,** of the Heriot-Watt College, Edinburgh, proposing "The Gas Industry," said that in his own life-time the Industry had developed greatly. They had to ensure that progress would continue. There would be a great scramble after the war for men of character, ability, and training. Gas managers were public benefactors, their commodity being essential in every home, and they must continue to attract into the Industry personnel of ability. Many young men were being highly trained in the electrical industry, and they would have to see that all the young men did not enter the electrical field. They should lay their plans to ensure that they got the right men back from the war, refreshed and re-trained, who might be of service to the Industry and to the country. There was not enough specialized training, and a good training in mechanical engineering or chemistry would be excellent for young people entering their Industry. Scotland had many sparsely-peopled areas, and they might find it necessary to concentrate young people in one centre for eleven or twelve weeks' training. One of the great difficulties of the present time was to make the results of research known to the ordinary man. What had been done by their Association was only a fraction of what could be done.

Mr. **J. Jamieson** (Edinburgh), replying said it seemed to him that it was not inopportune at this time, when thoughts of reconstruction were forcing their way hopefully above the welter of destruction, to try to detach themselves from the hurly-burly of wartime problems, and to turn their thoughts to the future and the things by which that future would be conditioned. These things must, however, in the first instance at least, be the fundamental things. They must try not to be distressed by the cries of the axe-grinders, and to be sure that there was no taint of axe-grinding in their own attitude. They must ask themselves first whether their products were the result of processes which were chemically and economically sound enough to justify the application of trained and energetic minds to their future development, and if so, what kind of men would be best fitted to develop these processes to the greatest advantage. The answer to the first question was that carbonization was the most efficient process so far devised for extracting the potential heat of coal. It was generally accepted as being at least twice as efficient as burning coal in the raw state. If, therefore, they ultimately got a national fuel policy directed towards the most efficient use of coal, then the prospects of the carbonizing industries would be distinctly bright.

It was always dangerous to assume the mantle of prophet, but a sober review of the present known methods of coal treatment suggested there was no present prospect of an efficient process which eliminated the production of gas. If, therefore, the most efficient methods of coal treatment involved the production of considerable quantities of gas, then, to get the most from their coal, the gas must

be used, and the Gas Industry was surely the medium through which it would be distributed for use. This did not mean that the proportions of the solid, liquid, and gaseous products of carbonization would remain stable; indeed, they were not stable, even from week to week under present gas-works practice. There was to-day a school of thought in the Industry which advocated complete gasification without solid residue in the form of coke, and which maintained that by selling coke as a fuel they are forcing upon the consumer something he did not really want; that the demand to-day was for fuel on tap which would abolish stoking and the removal of ash, and the dirt to which these gave rise. Against this view it was contended that so far as the domestic consumer was concerned, a solid fuel fire was just what he did want, in spite of the ash and the stoking, and he had no intention of giving up the open fire in favour of gas. If the latter view was correct, then there was a great potential market for coke, which might permit of the price of gas being reduced by the production of more instead of less coke at the gas-works.

It was not his intention to take sides on matters which left room for legitimate differences of opinion. He instanced the complete gasification controversy as an indication of the possibility of change in the process of the Industry. Their products were not yet perfect as regards either the efficiency of the production process or their suitability for the markets in which they tried to sell them. If, for instance, coke was to find a secure place in the domestic sphere, much of the coke produced would have to be brought up to the standard required by this rather fastidious market. The improvement, or for that matter the complete elimination, of coke might bring about great changes in gas-works practice. It might involve changes in the temperature of carbonization, or in the treatment of the coal before or the coke after carbonization. Again, there might be a field for gas as a motor fuel, but it had at present obvious disadvantages which must be overcome for gas to come into general use for this purpose. It might be that in the future greater attention would be devoted to the liquid products of carbonization, possibly by means as yet unsuspected.

The important lesson to learn was that the Industry must be adaptable to changing circumstances. Like every other industry, it was in constant danger of being superseded by new ideas and inventions, and it must, like an army in battle, react both to danger and to opportunity. The personnel of the Industry must therefore be adaptable, ready to adopt new ideas which were good, capable of assessing and rejecting those which were bad. Adaptability of this order could come only from sound technical knowledge, and he suggested that there would be room in the higher ranks of the gas business only for those who had had a good practical training, backed by a thorough theoretical knowledge of the principles of the chemistry of coal treatment.

The Industry was crying out to-day for good technicians, and this was particularly evident, he thought, on the side of utilization. It was futile to have a highly efficient process for extracting the potential heat from coal if the public either did not know about it or did not readily accept the means of utilizing the products of that process. It was in the solution of these problems that the future should bring a closer collaboration through management between the technician and the salesman. The type of management that was required was one which would be constantly trying through the medium of its sales organization to sense the trend of public opinion, to find out how their prestige stood with their customers, and trying through the medium of the technicians to provide the apparatus of utilization which would satisfy the public demand.

The outlook of management in the Gas Industry of the future must, too, embrace more than the control of a particular undertaking. It must appreciate not only the trends in technical research and in public demand, but in the developments of modern business and commerce. These developments of late years had been towards an ever closer co-operation between individual units, and towards the unification of industry and commerce on a national basis. There was evidence that the Gas Industry still had room for men who had the vision and ability to sacrifice an immediate gain to their own undertaking and work for the good of the Industry as a whole. A national fuel policy which would contribute so much to the prosperity of both the carbonizing industry and of the nation would undoubtedly be easier of attainment if they had the men in the Industry who would recognize the need for co-operation not only within the Industry but with the Government departments, and even with those industries which were now regarded as competitors.

This was a complicated Industry, becoming even more so, and its clamant need was for more and more specialists, specialists in technical research on production, in utilization, specialists in market research and selling, and above all, specialists in management, men of education, experience, and broad outlook. Given such men there was no fear that the Industry would fail to provide them with the remuneration to reward their zeal, for it ought to be one of the wealthiest and most prosperous of any in the land.

Sir **Patrick J. Dollan** (Chairman of the Scottish Fuel Efficiency Committee), proposing "The City of Edinburgh," thanked Principal Smail for what he had done at the Heriot-Watt College to assist the economy campaign, and expressed the hope that fuel efficiency, if not fuel economy, would be a regular part of the curriculum. The Gas Industry returned to the public 80% of the value of the coal it used and made a more efficient use of coal than any other industry. The reason why there were not so many candidates for the Industry was because local authorities did not pay adequate salaries. In smaller towns the gas manager's job was in the category of sweated labour. Local authorities who saved at the expense of the technical people in the Industry were asking for inefficiency, and were preventing young men from coming into the Industry and getting a chance to make it 100% efficient. Smokeless cities, said Sir Patrick, meant healthier and happier people. Coal was getting scarcer and more valuable every day and no fuel should be wasted. Its use should be controlled, and coal should be distributed where it gave the best results. The Gas Industry should get the best coal because it made the best use of it. People who were shouting for brighter streets should remember that it was impossible for the gas and electricity industries to meet their wishes unless there was greater production and greater economy. The removal of the black-out would mean an increase of 10% in coal production, and this at present called for intensified economy. They should give consideration to the fuel possibilities of peat to compensate for the decreased production of coal. There should be in Scotland a Fuel Board, with representatives of all fuel users and producers.

Sir **William Y. Darling** (Lord Provost of Edinburgh), replying, paid a tribute to Sir Patrick's work in connexion with fuel economy.

Mr. **R. Fife** (Kilmarnock) expressed the thanks of the Association for the hospitality of Edinburgh Corporation.

It was intimated that Mr. J. M. Dow, Kirkcaldy, had been elected Junior Vice-President, with Messrs, E. G. Smith, Dunfermline, and W. Nicol Baird, Perth, as members of Council. Mr. A. Jamieson, Johnstone, was invested with his chain of office as incoming President.

Lord Provost Darling auctioned for the Red Cross Fund three bananas grown in Edinburgh with gas heating realizing £8 10s.

A Glimpse into Refractory History

Writing on the importance of refractories in the August issue of the *Refractories Journal*, J. H. Hartley referred to their origin. The following is a brief extract from his interesting article:

Refractories in some form or other must have been used in the Bronze Age, for the extraction of metals from their ores requires some form of furnace or crucible. The manufacture of bricks in one form or another has been carried on from an early period, in fact, most of us are aware that the Israelites made bricks of clay in Egypt, but it is evident that the Romans introduced manufacture of bricks into this country. The Romans also developed metal-working in Great Britain into a considerable industry, during the early centuries of the Christian Era. The centres of the metal industry were the Forest of Dean, North Wales, Derbyshire, Yorkshire, and Cornwall. In the North Wales area Roman brick kilns have been found close to their lead mines, and the local fireclays have probably been used more or less continuously since the days of the Roman occupation. Little is known of the use of refractories between the time of the departure of the Romans and the fifteenth century, when certain glass-workers, according to tradition, were driven from the Continent by religious persecution and found a new home at Stourbridge. They continued in their old trade and found fireclays for their glass-pots near at hand. The Stourbridge fireclay became well known during the seventeenth century when it was being carried on as far afield as London. A century later, Nash, who visited the Stourbridge clay pits, stated that the deposits were then confined to an area of about 50 acres; the output being about 4,000 tons a year. The subsequent growth of the fireclay industry in the Stourbridge area was rapid; and in 1852 the output was 46,000 tons, while in 1874 it had risen to nearly a quarter of a million tons.

There is little mention of the manufacture of refractory materials in the Sheffield district until the latter half of the eighteenth century. Huntsman then developed his crucible steel-making process and used ganister as a crucible material. The consumption of ganister was greatly increased when Sir Henry Bessemer introduced his process of steel-making a century later. The fireclays of the Loxley and Little Don valleys were also in use at an early date; tradition maintains that the fireclays of these valleys have been in use for upwards of three centuries.

The fireclay required for the copper and iron industries of South Wales was in the first instance carried thither from Stourbridge but the district has the honour of being the cradle of the silica brick industry. The first silica brick was made in 1820 from rock quarried at Craig-y-Dinas in the Neath valley; bricks of this type were long known as "Dinas" bricks, and found immediate use in the rapidly expanding steel industry of the country.

In Scotland the Glenboig seam of fireclay was first worked in 1836; and since about 1860 the progress of the Scottish fireclay industry has been rapid.

Mehanite Iron Castings ranging from ½ lb. to 30 tons for various industries requiring high duty and heat-resisting qualities are illustrated in a new leaflet issued by Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees. The major portion of their plant has been adapted and mechanized for the bulk production of castings ranging from a few pounds in weight to over one ton, the remaining sections being equipped for the manufacture of larger castings by manual labour in green sand, dry sand, and loam up to 30-ton pieces.

The Future of the Gas Industry

Further Observations of the Association of Smaller Municipal Gas Undertakings

THE Association appreciates the opportunity afforded to it by the Minister of Fuel and Power to make further observations on the future of the Gas Industry in support of its report dated Dec. 30, 1943, and in this paper hopes to make a contribution which will be of assistance to the Minister and his Special Committee, and which, while expressing the opinion of the smaller municipal gas undertakings, will contain constructive criticism of the existing reports and constructive proposals for the benefit of the Industry as a whole.

Possibilities for Examination

In considering the structure and organization of the Gas Industry, and after careful perusal of the various reports prepared by bodies interested in the Gas Industry, the Association has reviewed the following aspects of the problem and, in commenting on these, appreciates that there may be other avenues unexplored but worthy of consideration.

1. Nationalization

The Association, while appreciating that there are certain advantages in the nationalization of public utility undertakings, is of the opinion that this policy should not be applied to the Gas Industry unless and until it is applied to industry as a whole, and until that time it can find no evidence that such policy would be in the best interests of the Gas Industry. Any advantages which might be brought about by nationalization—*e.g.*, control of labour and prices, equalization of prices, and use of resources—can be obtained to a marked extent by other methods, without incurring the political issue.

2. Total Municipal Ownership

The Association has found abundant evidence that the municipal ownership and management of gas undertakings has, generally speaking, proved very successful, and submits that this opinion applies to both large and small municipal undertakings; instances of less successful municipal gas undertakings may be found, and here again the Association draws attention to the fact that this type of gas undertaking is not confined to the smaller undertakings. Reference to this position is made later. (See reference in conclusion to Gas Engineering Advisory Board.)

The Association is of opinion that total municipal ownership is preferable to nationalization in so far as it maintains local pride of service and achievement, and that a high standard of competence in management is influenced by the fact that the gas consumers are also ratepayers, and therefore take a local interest in the efficiency of the local public utility undertakings. By the control of prices charged for gas supplied and by the method of sanctions to borrowing for capital purposes, a sound financial control is exercised by the Government through the Ministers of Fuel and Power and Health, ensuring that excessive prices are not charged, and that a local authority does not incur capital commitments beyond its capacity. The system of gas examination provides a degree of control.

The right to use the rates and revenues of the general and other rate funds as security for monies borrowed gives to the gas undertakings of municipalities a financial position not enjoyed by private enterprise, and the limitation of the period for repayment of loans adds to the undertakings' financial stability.

3. Total Private Ownership

The total ownership of the Industry by private enterprise is one which the Association cannot support, as it considers that public utility undertakings should be publicly owned or subject to strong Governmental control. The present form of ownership is such that many difficulties would arise in the transfer of municipal undertakings to private ownership, and such transfers would create considerable opposition from the general public.

The total ownership of the Industry by finance corporations is also, in the opinion of the Association, not in the best interests of the Gas Industry, as in such cases the investors concerned in the purchase of gas undertakings must and do consider firstly the profits to be derived from the investment, and secondly the interests of the gas consumer.

4. Ownership by Municipal and Private Enterprise

The Association is of opinion that the present structure of the Gas Industry, having evolved from a period of trial over some 90 years, has proved its efficiency in general terms by the manner in which it has progressed, particularly during the past 45 years in face of the competition of the electricity industry, also by the manner in which the Gas Industry has undertaken the very heavy burdens placed upon it by two major wars. There are, admittedly, gas undertakings, both private and municipal, which are not as efficiently administered as the Industry as a whole would like, and the Association is of opinion that this is one of the main features to be remedied. (See reference in conclusion to Gas Engineering Advisory Board.)

The proposal of the British Gas Federation for the integration of gas undertakings and the methods proposed by the Federation for operating their scheme are matters which this Association strongly opposes on the grounds that the method suggested is unconstitutional in so far as it deprives Parliament of the right of giving final decisions in such matters, and that the scheme is intended to enable a smaller unit to be absorbed by larger units, irrespective of whether or not the smaller unit is efficiently managed. The Association is of opinion that this is a retrograde step and one which should not be permitted.

The question of absorption or amalgamation of gas undertakings is, in the opinion of the Association, one that should be dealt with by the undertakings concerned, but it considers that no such absorption or amalgamation should be permitted without the prior sanction of the Minister of Fuel and Power.

5. Coke Oven Gas

The Association draws attention to the fact that municipal gas undertakings were the first to appreciate the value and use of surplus coke oven gas. In the use of this type of gas the Association considers that certain safeguards are essential owing to the fact that the suppliers are usually limited liability companies which, owing to circumstances sometimes beyond their control, may be unable to carry out any contract entered into between owners and the distributing party.

The Association considers that greater use should be made of surplus coke oven gas, and feels that by making certain safeguards more gas undertakings would be prepared to receive a quota of the available supply.

Consideration has been given to the policy of the formation of a National Board for the control of the supply of this commodity, and the Association suggests that the Minister's Committee might give consideration to a proposal for the formation of such a national controlling body or of regional bodies responsible for the manufacture and supply of this type of gas to distributors.

6. Gas Marketing Board

Consideration has also been given to a suggestion that a benefit to consumers might be achieved by the formation of a Gas Marketing Board or Boards.

In favour of such a suggestion are (i) the stabilization of prices either nationally, regionally, or by districts; (ii) the fullest use of gas-making capacity would be controlled to the best advantage.

Against such a proposal are (i) price problems caused by the varying costs of gas manufacture; (ii) differences in quality of gas made.

The proposal is submitted for consideration by the Minister's Committee.

7. Legislation, Accountancy and Other Matters

The Association supports the general desire for a revision and consolidation of existing legislation dealing with the Gas Industry and would welcome improved methods of accounting and costing. On these matters the Association would draw special attention to the question of the non-statutory gas undertakings, and suggests that the position of such undertakings is one that should be dealt with in any new legislation which is brought forward.

Conclusion

In attempting to summarize its views on this most intricate problem the Association submits that the present structure of the Gas Industry should be permitted to continue functioning as at present; that experience has shown that integration has been taking place over a very long period of years by mutual consent, and therefore submits that no other system is required to deal with this natural evolution of the Industry.

The Association considers that the inefficient undertakings should be dealt with firstly by advice from the Ministry of Fuel and Power, secondly by the strengthening of the existing Gas Engineering Advisory Boards, and thirdly by improvement in the methods of gas examination. The honorary members of the Gas Engineers' Advisory Boards have, during past years, played a most useful part in the improvement of the operations of making and distributing gas, and by strengthening these panels the Association considers that every gas undertaking will have the opportunity of making itself efficient, or more efficient, as the case may be. In such circumstances there should be no excuse for an inefficient gas undertaking, and if such an undertaking should then in fact exist the Association considers that the Minister, through his Department, should have power to call upon the proprietors to put the undertaking into efficient order.

The Association is of opinion that stability in the price of gas to consumers is of prime importance to the future prosperity of the Industry, and therefore submits that the question of the practicability of obtaining a standard maximum price for gas supplied over the whole

country should be most carefully reviewed. In this matter consideration has been given to the difficulty that may be encountered by reason of outlying consumers, and the suggestion is therefore made that in determining maximum prices it may be necessary to provide for District or Regional maxima to meet this difficulty.

The Association supports the establishment of the British Gas Association, with the reservation that there should be more proportionate representation of the various types of gas undertakings, and that the present heavy bias of the large undertakings should be removed; it further considers that if that Association intends to invite into its councils representatives of other organized bodies connected with the Gas Industry it should invite all such bodies to accept membership, and not select or reject as the members of the Executive Council of the British Gas Association so determine. There is no doubt in the mind of this Association that a properly constituted British Gas Association, with proper representation of all interests, with its ability to provide research facilities for all concerned, from the largest undertaking to the smallest, and with its power to collate statistics for the benefit of all gas undertakings, will give to the Minister in future years an organization upon which he can rely as speaking for the Gas Industry as a whole, and therefrom the Minister will undoubtedly be assisted in his duty of assuring that the best possible use is made of the nation's fuel resources.

In submitting these observations care has been taken to avoid the inclusion of statistical evidence, as it is considered more desirable that such evidence should be given in oral examination, in preference to an attempt to include a mass of detailed statistics in written observations.

The Association expresses its thanks to the Minister and to his officers and to his Committee for the courtesies extended to it from time to time since its formation, and for the opportunity of placing these further observations before them.

This Report has been considered and approved by a general meeting of the members of this Association and is submitted to the Minister of Fuel and Power.

F. J. HARRISON, *Chairman.*
F. L. WIMHURST, *Hon. Secretary.*

Aug. 24, 1944.

National Gas Council

A Meeting of the Central Executive Board of the National Gas Council was held on September 12, by courtesy of the Lord Mayor of Leicester in his suite of rooms in Hastings Street, Leicester. Mr. A. E. Sylvester presided, and welcomed Mr. T. Reynolds, Stockport, who had been appointed by the Manchester District to be one of its four representatives on the Board.

It was reported that, under Rule VI, Paragraph (2) of the Constitution and Rules of the National Gas Council, the following had been elected to serve on the Board: Mr. John Terrace, Colonel C. M. Croft, Sir Frederick J. West, K.B.E., and Dr. E. V. Evans, O.B.E. Sir Frederick J. West took the place of Mr. George Dixon, who was already a member of the Board, representing the Midland District.

The Chairman referred with deep regret to the death of Mr. T. P Ridley, who after being a member of the Board for twenty years had resigned in 1941, when he was elected an Honorary Member of the Council in recognition of his very great services to the Gas Industry on legislative matters, gas charges, &c. Mr. W. J. Smith had represented the Board at a memorial service at Newcastle on August 14, and a letter of sympathy had been sent to Mr. Crowther on behalf of the Board. Other members, including Mr. Bradshaw and Mr. A. W. Smith, paid personal tribute to Mr. Ridley, and a letter was read from Mr. Crowther regretting that he was unable to be present in person to add his testimony. A vote of sympathy was passed, the members standing in silence.

A letter was received from Mr. Samuel Tagg, C.B.E., intimating that he would be relinquishing his activities in the Gas Industry. Mr. Tagg had been a member of the Board since 1919, and had held many important positions in the Industry, including that of President of The Institution of Gas Engineers. He had also been Chairman of the Manchester District Executive Board since 1931. The announcement of his resignation was received with general regret, and a warm tribute was paid to him by Mr. Bloor, who proposed that Mr. Tagg should be made an Honorary Member of the Board. This was seconded by Mr. A. W. Smith, supported by Col. W. Moncrieff Carr, and carried with acclamation.

Coal.—(*a*) A letter from the Ministry of Fuel and Power which had been circulated asked the Council to put forward two or three alternative names, from which the Ministry could appoint a successor to Mr. Tagg on the Public Utilities Coal Committee, which was now a Committee of the Ministry of Fuel and Power. The Board agreed to nominate certain representatives, and instructions were given for the Minister to be informed accordingly. (*b*) It was agreed that Col. F. J. Bywater, M.C., the Council's other representative on the Public Utilities Coal Committee, should be co-opted a member of the Board. (*c*) A report on the general position was received. (*d*) A lengthy and interesting discussion took place with regard to the general increase in the price level of coal, in which the following points were dealt with. (1) A letter of protest from the Council to the Ministry against the recent increase of 4s. per ton had been circulated to the Board, together with the Ministry's acknowledgment thereof; (2) resolutions passed by the Manchester, Northern, and Yorkshire (W.R.) District Executive Boards, copies of which had also been circulated; and (3) the proposed action of the Conjoint Conference of Public Utility Associations.

A report was received from the Chairman, Mr. A. E. Sylvester, on the meeting of the Gas Advisory Committee to the Ministry of Fuel and Power held the previous day, when the matters discussed had included the Committee of Enquiry into the Gas Industry and the evidence to be submitted thereto, increases in the price of coal, the price of gas, weather forecasts, supply of cookers, and the question of labour.

A letter from the Ministry of Fuel and Power had been circulated, enclosing copy of a Press Notice regarding the Hydrocarbon Oil Duties Committee, and asking for a written statement of the Council's views. It was agreed to refer the matter to the Benzole Committee of the Council.

It was stated that the Report of the Committee on Gas Legislation was now concluded and had been circulated. Members were asked to send in their observations in writing prior to the next meeting of the Board.

It was agreed to continue to retain the services of Messrs. Ryde, Sons & Browne so that members might consult them on general questions relating to rating and valuation.

It was agreed that the next meeting of the Board should be held in London on October 10, at 1.30 p.m.

Prior to the meeting the members of the Board were entertained at luncheon, when Councillor S. J. Perry, Chairman of the Gas Committee, welcomed the members to the ancient city of Leicester, which he was glad to recall had once before acted as their hosts during the earlier London "blitz." Councillor Perry went on to say that he always liked to remind guests that Leicester was an historic city, dating from Roman times, and the evidence of those times was still to be seen. One great figure in English history, Cardinal Wolsey, had died in their midst, and it was there that the statement was uttered which led to the following lines:

> "Had I but served my God with half the zeal
> I serv'd my King, he would not in mine age
> Have left me naked to mine enemies."

The ancient Town Hall and the Law Courts still preserved their medieval appearance, and he hoped that members would take the opportunity of visiting them. Subsequently, Councillor Perry and Mr. J. Mitchell, Gas Engineer and Manager, attended the meeting of the Board, by invitation of the Chairman. Mr. A. E. Sylvester and Mr. C. S. Shapley warmly thanked the Lord Mayor for allowing the use of the room and Councillor Perry for providing the hospitality, which was greatly appreciated by the Board.

A New Company has been registered in the name of W. H. Cooper & Co. (West End), Ltd., with temporary offices and works at Martins Bank Chambers, Bromley, Kent, to carry on business as service contractors to public utility undertakings, specializing in cooker renovation, vitreous enamelling, re-tinning grey iron castings, sheet metal work, cleaning and degreasing preparations, steel wool, and insulating materials. Mr. W. H. Cooper was formerly Sales Director of Grosvenor Utilities, Ltd.

Commodity Control.—Early last year a guide, in narrative form, to the whole of the Government's control of commodities, other than food, whether by Statute or by Rules and Orders, was published by Butterworth & Co. (Publishers), Ltd. Twelve months ago a first supplement brought the original work up to date, and the same publishers have now issued a Second (Cumulative) Supplement covering all the changes made up to June 1 of this year. Special care has been taken to include all new Orders that have appeared since the publication of the main work, and the supplement contains a table of all the Statutory Rules and Orders mentioned in the text, in their year and number order. It is claimed that by using the supplement in conjunction with the main volume, readers can be reasonably sure of having in front of them all the latest information on the subject of commodity control. The price of the 100-page supplement is 4s. 6d. (plus 4d. postage), and the combined price of the main work and supplement is 15s. (plus 9d. postage).

Announcing a Dividend of 6% per annum at the 151st Ordinary General Meeting of the Cork Gas Consumers' Company, Mr. E. T. Mahoney, Chairman, said the total expenditure on coal for the past half year showed an increase of £12,281 over the corresponding period of 1943. Supplies of coal had been cut to 75% of the pre-war consumption, and this had meant a much lower percentage of gas produced owing to the poor quality of the coal now being carbonized. To meet the coal restriction it had been necessary to introduce a stricter gas-rationing scheme for consumers. Ration cards were issued showing a basic ration in accordance with 1943 consumption, and the percentage of this ration which might be used was notified periodically through the Press. At present it stood at 60%. Orders had been placed well in advance for cookers and other appliances so as to secure priority in delivery when manufacturers were able to revert to civilian trade. Post-war reconstruction schemes had also been submitted to the Government so as to be in a favourable position to meet the expansion of business which would undoubtedly take place after the war.

Infra-Red Drying*

Some Experiments and Results with Gas-Fired Equipment on High-Speed Baking of Paint Finishes and Other Drying Processes Using Radiant Heat

By F. L. ATKIN, M.I.Mech.E.,

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1. Introduction

THE term "infra-red drying" has been accepted to a great extent by both manufacturers of painted and stoved metal articles and the paint and varnish suppliers notwithstanding the fact that a simpler and more expressive term would be "radiant heat." The electrical industry, utilizing lamps which are similar to 250-watt lighting lamps, has publicized the rapid drying of stoving finishes by these lamps, so that "infra-red drying" has become synonymous with high-speed stoving using radiant energy.

The subject has been well documented and is very popular, due partly to the post-war flavour, and partly to the innuendo of a "mystic ray" which the pseudo-scientist has attached to infra-red.

The application of gas as a source of radiant energy has proved entirely successful, producing higher flux densities than the existing electrical system, resulting in a shortened time of heating at a lower cost of capital, running, and maintenance.

The following Paper deals mainly with the use of gas for this purpose, giving details of experimental work, plant design, comparative costs, and installation.

2. Heat Transfer

The elementary conception of heat transfer is well known. Heat is transferred from a body standing at an elevated temperature to a cooler body. If the two bodies are in contact, heat is transferred by *conduction*. If the heat is conveyed by an intermediary fluid, such as a liquid, air or other gas, from the hot body to the cooler body, it is said to be transferred by *convection*. If the velocity of the liquids or gas is increased by pump or fan, it is called *forced convection*. When heat is conveyed from a hot body to a cooler body, neither being in physical contact, or in contact by means of a conducting medium, heat is transferred *by radiation*.

The exact nature of heat transfer is still in the hands of the physicists, while the mathematics have been dealt with at length by various writers, notably Fishenden and Saunders.(1) The application of the mathematics of heat transfer related to the subject of this Paper has also received a considerable amount of attention.(2, 3) These calculations have been based mainly on the heating of flat plates. To simplify the problem certain variables were eliminated, such as evaporation of solvents, effect of colour, re-radiation, non-uniformity of heating and unstable thermal conditions; nevertheless, by the adjustment of co-efficients, close agreement has been reached between calculation and experiment.

Although the drying by radiant heat is the primary purpose of this Paper, both conduction and convection are important in the process. In paint drying, for example, the article gains sensible heat by absorption of radiant energy, and heat transfer takes place by conduction between the paint film and the support. In practice there are also convection currents which are by no means insignificant and will be discussed later.

3. Radiant Heat

If an object is irradiated, the relative amounts absorbed, reflected, and transmitted depend on the physical properties (emissivities) of the receiver and emitter and the wavelength of the source of emission. The heat absorbed is usually manifested by sensible heat and rise in temperature, and it may be said that with the majority of heating processes this represents the largest proportion of transmitted heat. The overall efficiency, however, may be quite low due to the escape of emissions not intercepted by the receiver.

All practical sources of radiation are an integration of many wavelengths, but the peaks differ according to the source. This factor is important; for example, the longer wavelengths produced by medium temperature surfaces heated by gas exhibit smaller differences in drying times between one colour and another, compared with the shorter wavelengths produced by electric lamps.(4)

The writer inclines to the view of Maxted,(5) who says, "Radiant heating techniques still depend rather more on direct experiment than upon a full understanding of wavelength effects, the properties of materials or the physics of processes."

* Paper to the Midland Junior Gas Association in Birmingham on August 24, 1944.

Why "Infra-red"?

The first recorded work on the association of radiant heat with visible light was made in 1800 by Sir William Herschel,(6) the famous astronomer, who, in the course of his investigations with telescopes, experimented with coloured glasses on the eye-pieces. He found that certain colours reduced the light, but still transmitted heat, and *vice versa*. Since one of his principles was to allow no phenomena to pass without investigation, he devoted his energies for some time to this problem, and found that the red end of the spectrum could be extended beyond the visible light and yet cause a temperature rise. It is interesting to note that he had a remote connexion with the Gas Industry, as he was a distinguished visitor to the famous Lunar Society,(7) which was founded by Matthew Boulton in Birmingham in 1766, and which flourished for 40 years. The meetings were held every month near to the full moon, "in order to have the benefit of its light in returning home." The Society is now defunct, but it is open to speculation as to whether the introduction of gas lighting sounded the death knell of the Lunar Society, since one of its leading members was William Murdoch. The present blackout no doubt has introduced many informal Lunar Societies!

Since that time the electro-magnetic spectrum has been extended to cover ultra-violet rays, X-rays, and cosmic rays on the one hand, and on the other, the red end, infra-red, radio frequency, &c.

Early Work with Radiant Heating.

Although radiant heating is as old as the sun, it remained for the electrical industry to attach a label of "infra-red heating" to the use of the non-visible red end of the spectrum produced by electric vacuum and gas-filled bulbs. This followed the work of Groven,(8) of the Ford Motor Company, Detroit, who in 1932 was granted a patent for using an assembly of electric bulbs for patching up finished cars which had been damaged in the course of manufacture. This method was apparently successful, and during the following years literature records a number of cases of its use (9). The electric lamp manufacturers studied the problem and produced special lamps for the process, chief points of difference between the ordinary lighting bulb and the infra-red bulb being a more robust filament and slight under-running to give an increased life compared with the usual 1,000 hours of a standard lighting lamp.

FIG. 1.—*Sheet Steel Petrol Can.* (*From* "Application of Radiant Heat to Metal Finishing," *Nelson & Silman.*)

War Production.

The real fillip was given to the use of electric lamps for radiant heating by war production requirements, which frequently comprised large quantities of sheet metal articles finished in synthetic paints and varnishes, usually handled by a single-line conveyor. These conditions were eminently suitable for infra-red drying, but there is no doubt that the job which brought the system right into the limelight and is of such popular appeal is the manufacture of the special four-gallon petrol tank (10) (fig. 1).

4. Convection Ovens

Gas-fired.

Prior to the advent of "infra-red" drying, the normal method of stoving and drying was carried out in so-called box ovens which dealt with work in batches, or by the use of mechanized conveyor ovens. This method still is, and, in the Author's opinion will continue to be, an indispensable and important means of drying.

The ovens are usually constructed of sheet steel packed with insulation material such as slag wool or magnesia.

Batch type ovens may be fired with drilled tube burners, the products of combustion passing through and over the work, in which case they are known as double-cased ovens.

Some box ovens are constructed with an inner lining sealing off the products of combustion from the working space; they are then known as treble- or triple-cased ovens. Both types of stove may be fitted with a fan for circulating the hot air with or without the products of combustion.

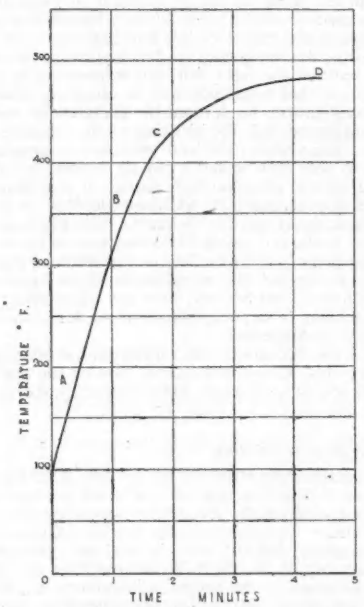


FIG. 2.—*Curve Indicating Rate of Temperature Rise of Sheet Steel Metal Panel in Radiant Tunnel.*

Conveyor ovens usually operate with forced circulation; when the products of combustion are used, they are known as "direct fired," and "indirect fired" when only the hot air is circulated.

There are other types of ovens which may have steam pipes or coke as a source of heat. An alternative method of construction is the use of brickwork for the walls.

The foregoing stoves are generally classed as convection ovens, but in practice the radiation effect, where the work is not shadowed, is very appreciable. Messrs. Andrew and Chamberlain[11] have shown that with natural convection, the heating of a metal plate to 220°F. in an oven standing at 250°F., 65% of heat is received from direct radiation, and under similar conditions, but with forced convection, this figure is only reduced to 48%. In a similar manner, the conditions inside the treble-cased stove may be regarded as those appertaining to radiant heating, although owing to the manner of use, the convection effect is probably predominant.

The working temperatures of convection ovens depend on the type of paint or varnish, and are usually 250°F., 350°F., or 450°F. Both conveyor and box ovens are controlled by hand or thermostat to work at these temperatures.

5. Radiant Heating Tunnels

Gas-fired.

The present conception of a radiant tunnel is that of the radiating surface standing at a higher temperature than that obtained on the work. Thermal equilibrium between the emitter and receiver will be attained when the radiation absorbed and converted into sensible heat is equal to that lost by convection. Since the convection loss increases with temperature difference, the rate of increase when approaching equilibrium is very slow, as may be seen from a section of the curve between C and D (fig. 2); in practice, therefore, only the lower part of the curve from A to B is used, the work being taken from the tunnel at a predetermined time; hence the need for precise timing.

The limitation of speed of heating as far as gas is concerned rests with the ability of the paint to absorb radiant heat without spoiling, as very high flux densities up to 50,000 B.Th.U./sq.ft./hr. and more can be reached with gas. It should be borne in mind, however, that rapid heating with shortened times becomes extremely critical. In the course of many practical experiments it has been found necessary to reduce flux densities to produce workable limits and a reasonable conveyor speed.

It is commonly supposed that in radiant heat tunnels the air temperatures are low; this is only true when no intermediary in the shape of work is present. Immediately work is introduced and becomes heated, convection currents rise which can cause a considerable increase in air temperature approaching the work temperature.

In one experiment where some 24 labels about 1½ in. diameter by 26 gauge were dried while hanging on a support known in the trade as a Christmas tree, it was found that when approaching the critical drying temperature the upper labels were burnt. This was ascribed to the convection currents from the lower articles conveying heat to the upper ones, thereby producing more rapid heating, since the labels at the higher level were being subjected to radiation *plus* convection.

There are two conclusions to be drawn from this fact:

(i) that convection currents are useful and can be utilized for increasing speed of heating in the radiant tunnel, and—

(ii) that evenness of radiant source temperature from top to bottom is not always desirable—*i.e.*, in some cases a greater emitting temperature is desirable at the bottom of the stove. This important point will be mentioned later.

6. Comparison of Radiant Tunnels *v.* Convection Ovens

There are two important factors which constitute the main difference between so-called convection ovens and "infra-red" heating. For convection ovens the following are conditional:

(1) The work may be left in the stove for considerable periods in excess of the normal stoving time without being discoloured or otherwise spoiled.

(2) Articles of different shape, size, or thickness may be stoved together without spoiling, although it will be obvious that the smallest articles will have been finished first.

The corollary with radiant heating is that the articles are stoved—

(*a*) In a single line, or in such a manner as to avoid shadowing.

(*b*) On a rising temperature gradient, hence the controlling factor for a given source of emission is the time of exposure to the source.

As will be shown later, articles having large differences in their surface-to-weight ratio will require varying times of exposure, and for this reason it is not possible to stove such articles together. It follows, therefore, that this method of heating is essentially suitable for the mass production of work, mainly sheet metal, which can be handled by a single line conveyor. These and other factors will be discussed in some detail.

A consideration of the mode of heating in a convection oven leads to some interesting conclusions. There are two methods of operation:

(i) When the work is loaded into a cold stove and heat applied, either from direct burners or circulated hot air, or in the case of treble-cased stoves by natural convection.

(ii) When the work is loaded into a hot stove standing at the working temperature.

Considering (i): Under normal conditions and provided heat distribution is correct, the inner lining and the work will increase in temperature at the same rate. If the work is comparatively heavy, the probability is that the lining of the stove, having a relatively small thermal capacity, will have a temperature potential which will transfer a small amount of heat by radiation to the work which is not screened from the lining. The converse will also be true, the lining and work mutually exchanging heat. When the temperature is stabilized by thermostat or hand, it is probable that in double-cased stoves the lining is at a slightly lower temperature than the work, owing to heat losses to the outside through the lining and lagging.

Considering (ii) it being assumed that the stove is standing at the working temperature when the cold work is introduced: *in addition* to heat transferred by convection, heat will be received by radiation from the lining by the adjacent work, which will in turn transfer heat to the neighbouring work. Since heat will not be specifically supplied to the lining except in treble-cased stoves, the temperature of the lining will fall whilst the temperature of the work rises, until, ultimately, approximate thermal equilibrium is attained. Thereafter the same considerations apply as in condition (i).

It will be appreciated that the maximum time to heat a batch of material will be governed by the time taken to heat—

(*a*) the heaviest article, and/or

(*b*) that which is most remote from the radiating surface.

It is a natural conclusion, therefore, that heating times in a batch oven handling varying materials may be decreased by loading the stove selectively.

In the case of a conveyor oven working continuously with a temperature gradient caused by the entry of the cold work, the finishing condition corresponds to that of a box oven when stabilized, although it is most likely that the temperature of the lining will be lower than

the air, due to the forced convection which is usual with this type of stove.

An important point may be noted: times of heating can be decreased considerably by speeding up a conveyor oven and working at a temperature exceeding the required metal temperature, *provided* the same condition attached to radiant heating is applied—*i.e.*, that all articles have the same thickness and are similar. This has been achieved with success in several cases known to the writer.

7. Development of the Use of Gas for Radiant Heating

As the infra-red method of drying fulfilled an obvious need for certain manufactures, the Gas Industry investigated the use of its fuel for the purpose.

It will be realized that many applications of gas for heating fall into the category of radiant heat or "infra-red"—for example, gas fires, grillers, muffle furnaces, and the latest type of panel heaters for space heating.

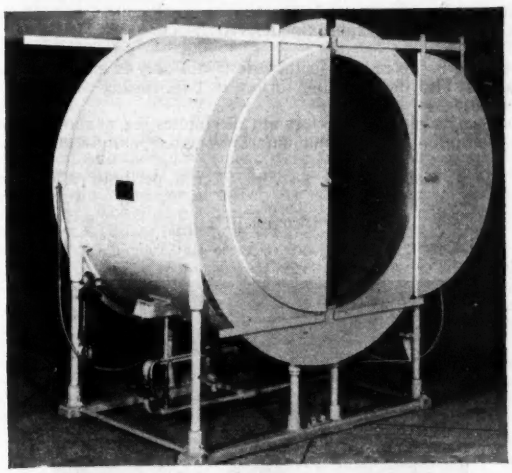


FIG. 3.—*Photograph of Gas-fired Medium Temperature Infra-red Tunnel. (Courtesy of the Gas Light and Coke Company.)*

Experiments were carried out in Birmingham with gas-lighting units, both high and low pressure types, with specially designed rhodium-plated reflectors with a certain amount of success, but these were suspended in view of the advantages and increased flux densities which could be achieved with the medium temperature black panel.

Further experiments were made utilizing emitting temperatures of the order of 700°–900°C. typified by the use of Cox's Ignite Combustors and modified gas fires. These sources gave flux densities very much higher than those required for paint drying on sheet metal, although they were very useful where heavy and thick articles had to be dried. The Paint Division of Imperial Chemical Industries has developed

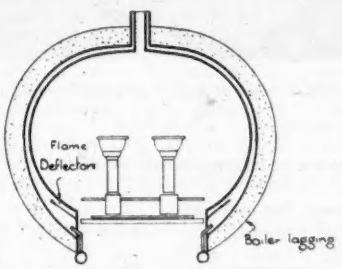


FIG. 4.—*Cross-section of first Infra-red Tunnel made by Birmingham Gas Department.*

the use of refractory surfaces heated by gas or electricity to temperatures of the order of 1,000°C.; this is the subject of British Patent No. 9092/41 [12].

The Gas Industry is indebted to the Gas Light and Coke Company for a considerable amount of original work in the development of the medium temperature panel known as the "black emitter." This has been described by Andrew and Chamberlain, [13] who showed that with panel temperatures of 600°F. flux densities of 3,000/4,000 B.Th.U. per sq.ft./hour were obtainable. With 250 watt electric lamps, flux densities of 415/837 watts/sq.ft. are obtainable corresponding to figures of 1,420/2,900 B.Th.U./sq.ft. per hour[14]. Fig. 3 is a photograph of this unit.

An experimental unit was made in the Industrial Heating Section of the Birmingham Gas Department following similar lines, but dispensing with the refractory lining in favour of sheet metal covered on the outside with plastic insulation (fig. 4). A number of experiments for a local firm were carried out which provided sufficient data and encouragement to justify the construction of a 9-ft. tunnel with a bottom conveyor (fig. 5), which has since been used for a considerable number of tests. The external application of plastic insulation was not good from a heat insulation point of view, and was dispensed with in favour of an inner metal lining backed with slag wool.

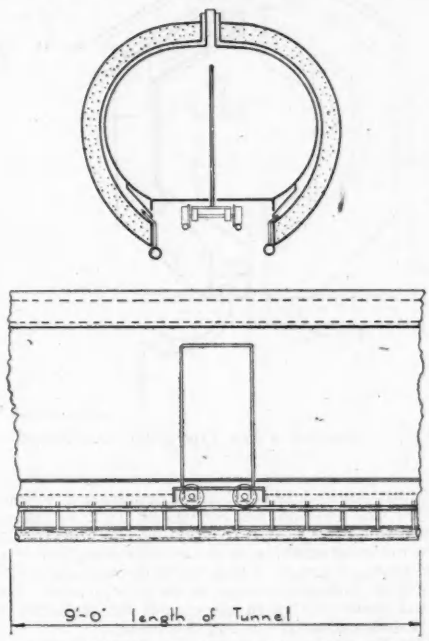


FIG. 5.—*Drawing of 9-ft. Experimental Tunnel made by Birmingham Gas Department.*

From the experimental data obtained, the firm concerned constructed a 9-ft. tunnel essentially similar to fig. 5 for comparison with an existing electrical tunnel. A photograph of this is shown in fig. 6, and the results of the comparison are given in Table I. This plant is now in full production, together with several others, the latest type being manufactured by Messrs. A. E. Griffiths, Ltd., of Smethwick.

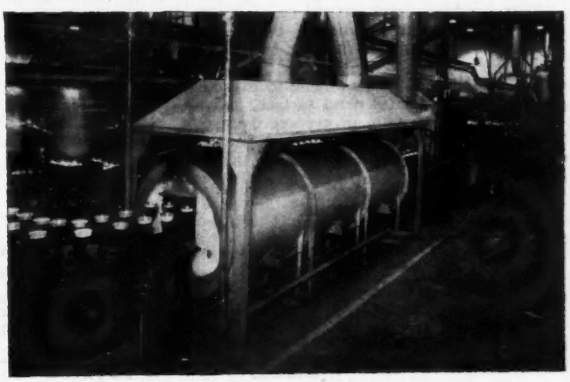


FIG. 6.—*Photograph of Infra-red Tunnel. (Courtesy of Messrs. J. Lucas, Ltd., Birmingham.)*

TABLE I.—COMPARISON OF GAS-FIRED RADIANT TUNNEL AND ELECTRIC INFRA-RED TUNNEL.

	Gas.	Electric.
Output of articles per hour	600	600
Length of heating zone	9 ft.	32 ft.
Time to pass through heating zone	1·7 mins.	6.6 mins.
Cost of installation	£135	£1,920
Energy consumption per hour	480 cu.ft. (2.16 therms)	96 kwh.
Running cost per hour for 600 articles ...	1s.	4s 9d.

New Design of Experimental Oven.

As an alternative to the circular type of oven and to carry out further investigations, the experimental oven shown in fig. 7 was designed by the writer and constructed by Messrs. A. E. Griffiths, Ltd. Photographs are shown in figs. 8 and 9.

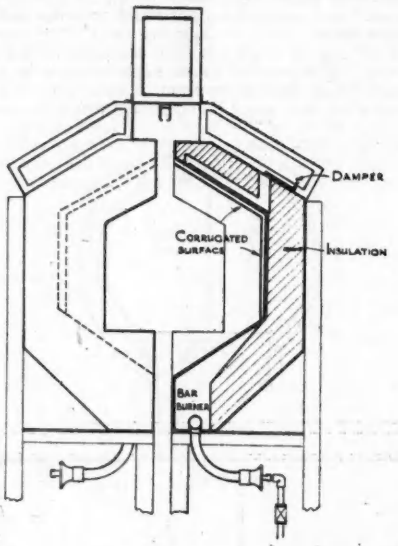


FIG. 7.—*Drawing of New Type of Infra-red Tunnel.*

The particular points considered in the design are as follows:

(1) The side and top are corrugated, as it was thought that not only would an increased radiating effect be obtained, but also the radiation would be more unidirectional, thereby speeding up the drying of surfaces which travel through the oven at right angles—such surfaces as occur on box-like articles. (It should be stated however, that in many cases the conductivity of the metal is sufficient to take care of this point.)

(2) The flue products are reversed at the top panel—

(*a*) to avoid the high aeromotive effect of the column of hot gases.

(*b*) to increase the scrubbing effect of the flue products.

(*c*) to divert the flue products from the conveyor chain.

(3) The cross-section is hexagonal, this being more suitable to the drying of rectangular objects having a long length as compared with width.

(4) Bar burners with single injectors are used, enabling luminous or non-luminous flames to be obtained at will.

(5) The burners are accessible for cleaning and lighting up, mica windows being provided.

(6) The two halves are self-supporting and adjustable.

(7) The radiating surface can be replaced easily.

This oven has been very useful for carrying out a number of investigations. An endeavour was made to make comparison between the corrugated surface and a plain surface, and fig. 10 shows the result. It will be seen that with an average oven temperature of 650°F., a 22-gauge by 6 in. by 6 in. matt black painted test panel was heated to 338°F. in one minute with the corrugated surface, as compared with 292°F. with the flat surface. Table II gives a further comparison.

It will be seen that with a 22-gauge sheet, a temperature of 250°F. was obtained in 37 seconds with the corrugated radiation surface, as compared with 46 seconds when using the flat surface—a decrease of 20%.

The comparative gas consumptions are also interesting:

(*a*) With corrugated surface, average temperature 650°F. . . . = 157 cu.ft. per hour (0.707 therm).

(*b*) With flat surface, average temperature 650°F. . = 137.5 „ „ (0.618 „).

Increase = 14%.

From these results it would appear that the corrugated surface is justified.

A further series of tests were carried out to ascertain the effect when allowing an air gap of 2 in. at the bottom of the tunnel which is sometimes necessary from certain practical considerations. Fig. 12 shows in graphical form the results of a selection of these tests, from which it will be seen that for a 22-gauge sheet, the time to reach 250°F. is increased by about 5%, but the difference is more obvious on the thicker sections; for example, the time to reach 250°F. on a 10-gauge sheet is increased by approximately 10%.

It should be noted that in these tests not only is an air gap introduced, but also the radiating surface is 1 in. further away from the test sheet.

The relative gas consumptions are also interesting, as shown below.

Consumption of gas to maintain average temperature of 650°F.:

With tunnel closed . 157 cu.ft. per hour (0.707 therm).
„ „ open . 185 „ „ (0.833 „).

Increase 18%.

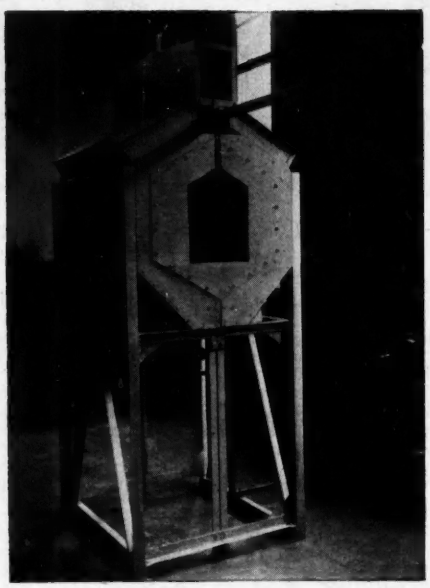


FIG. 8.—*Photograph of New Type of Infra-red Tunnel.*

TABLE II.—COMPARISON OF DIFFERENT TYPES OF RADIATING SURFACE IN MEDIUM TEMPERATURE GAS-FIRED INFRA-RED TUNNEL.

Time to heat test panels of sheet steel 6 in. by 6 in., painted one coat matt black from 100° F.:
(*a*) With corrugated surface, average temperature 650°F.
(*b*) With flat surface, average temperature 650°F.

Thickness.		Time to reach—							
		220°F.		250°F.		350°F.		450°F.	
Ins.	I.W.G.	(a) Secs.	(b) Secs.	(a) Secs.	(b) Secs.	(a) Secs.	(b) Secs.	(a) Secs.	(b) Secs.
0.028	22	30	37	37	46	64	81	105	138
0.056	17	38	43	48	55	85	100	144	180
0.072	15	43	50	55	64	100	120	180	223
0.132	10 (approx.)	60	69	79	87	153	178	270	333
0.242	—	103 mins.	113 mins.	133 mins.	152 mins.	258 mins.	321 mins.	480 mins.	630 mins.
0.312	—	1.8	2.35	2.35	3.20	4.9	6.65	9.0	13.0
0.385	—	2.25	2.75	3.05	3.80	6.55	8.15	12.30	16.60
0.597	—	3.50	4.40	4.60	6.00	9.40	12.60	17.20	24.20

(*To be continued*)

Some Aspects of Administration in a Small Works*

By W. A. CURRIE,

Engineer and Manager, Renfrew Corporation Gas Department

(*Concluded from p. 344*)

PART II.—COSTING AND FINANCIAL CONTROL.

The cost system in use in Renfrew is designed with the following objects in view:

1. Determination of the cost of gas manufacture.
2. Comparison of items of expense under various headings with corresponding data of other cost periods.
3. Analysis of cost data for estimating future expense.

It has been designed to give detail within the limits set by the staff available and a percentage accuracy of ±1%.

The general scheme of the system is shown in fig. 2, and the various documents may be briefly described thus:

1. Time sheets: Each man whose time is not wholly given to one job has a weekly sheet on which he marks his time each day. The account number of the various jobs is marked in each week by the man's supervisor, and the value worked out by the cost staff and entered in the appropriate accounts. A man's time will range over four or five accounts at most. Staff without time-sheets are charged through a time-book.

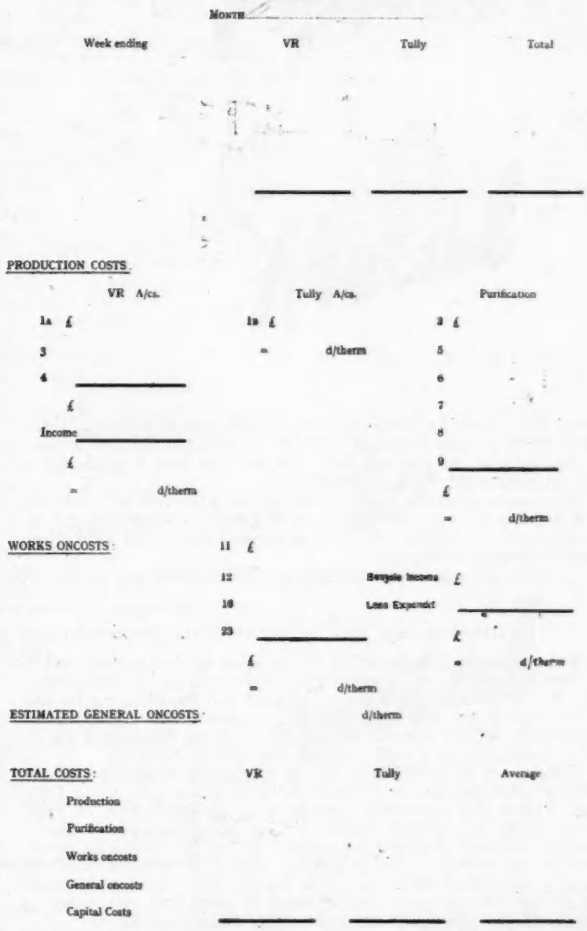
2. Invoices are collected and checked for payment monthly, classified and marked with the appropriate cost account number, summarized in an analysis sheet and debited. Invoices may be classified into three groups: (*a*) coal and gas oil which are not allocated; (*b*) operational stores—*e.g.*, lubricating oil, pipe fittings, and what can be allocated to specific cost accounts but not to specific jobs; (*c*) special stores—*e.g.*, spare parts which can be allocated to specific jobs and accounts. Coal and oil are evaluated from the coal sheet on which the daily and then weekly consumptions are noted. Although records are made of the consumption of lubricating oils and each item of stock is recorded on a requisition note intended to control stores issue and provide data for the cost staff, this has not been carried into effect, due to lack of the necessary staff. Experience over the last four years indicates that the invoice system is accurate enough for the purpose, as issues are either rigidly controlled, such as lubricating oils, and so result in regular quite small orders being placed, hence regular accounts; or averaging of expense in account takes place automatically by the stores ordering say one-inch fittings this month and inch-and-a-half next month. Under war conditions the major expense on coal and oil quite swamps the variations in the small items and so maintains the percentage accuracy.

Cost Ledger Accounts: The names of the various accounts are given in fig. 2. Accounts 1A, 1B, 2, 3, 4, 5, 6, 7, 8, 9, 10 cover fairly orthodox divisions of the works. Each of these accounts is divided into two sections: (*a*) Operating expense, (*b*) maintenance expense, and under each section the appropriate debits are made. The maintenance expenses as a whole are brought out separately on the cost analysis sheet, since these figures have a notable significance in the management of the plant. Account 11 covers all expenses due to civil defence measures excepting fire-guard subsistence, which is ignored, as are all other recoverable expenses of the same type. Works oncosts are collected in 12, which is divided into general works oncosts, and sub-accounts for expenses due to the Muirhill shovel, &c., which are characterized as being difficult to allocate directly to any of the previous accounts. At the end of a period the totals of the sub-accounts could be allocated, but that is not commonly done, the objects of the accounting not requiring it. Account 13 collects all the expense due to maintenance of mains and services, including clearing liquor traps, cleaning governors, &c.

The costs of fitting cookers, waterheaters, fires, and other appliances are worked out from 19, 19*a*, 19*b*, 19*c*, 19*d*. An average figure can be worked out as desired for quotation purposes, but present conditions do not encourage activity in these directions, and development of this section of the system will be required in due course. Account 20 collects distribution oncosts just as 12 collects works oncosts. Under 22*a*, 22*b*, &c., we have accommodation for all short-term jobs, such as erection of a new plant or an extension of mains, the point of interest here being the comparison of totals with estimates and the analysis of data after closing the account. Account 24, 25, 26, 27 were used for large capital jobs which ran for years and involved comparatively large sums. Under 23 we have collected all fixed oncosts whether applicable to works or distribution. These are known in advance, and include income tax, rates, insurance, certain pensions, &c., and certain salaries. A sub-account of 23 collects miscellaneous expenses not allocatable to any other account. The "gas sheet" and the "coal sheet" are weekly sheets which collect daily (1) the data referring to meter indices, meter temperatures, holder stocks, gas made and delivered per shift, corrected make and delivery and make and delivery in therms, and (2) coal carbonized in retorts, coal and oil gasified in

FIG. 4.

COST OF GAS MANUFACTURE



* Paper to the North British Association of Gas Managers, Sept. 8.

	Income.		Gross Manufacture.		Distribution.		Oncosts.		Maintenance.		Balance.		Nett Manufacture.	
	£	£	d.	d.	d.	d.	d.	d.	£	£	£	£	d.	d.
May ...	2,353	3,200	8.6	8.0	1.6	1.8	3.35	2.9	137	185	+606	+1,523	5.4	5.3
June ...	3,853	3,089	8.0	7.8	1.15	1.85	3.65	3.2	206	234	+1,280	+1,571	5.4	6.2
July ...	3,430	3,107	8.45	8.33	0.9	1.35	3.65	3.3	461	191	+675	+797	5.75	7.1
August ...	3,285	3,161	9.35	9.05	2.5	1.05	4.1	3.1	361	243	+474	+682	5.8	7.2
September	3,098	3,090	7.4	9.55	1.9	2.05	3.55	3.5	272	300	+473	+227	6.3	7.3
October ...	3,663	3,660	7.75	8.5	1.2	1.6	3.1	3.15	455	268	−314	−198	5.55	6.23
November	3,765	3,746	8.55	8.4	1.65	1.0	3.2	2.7	364	106	−205	+33	5.65	6.15
December	3,981	4,278	7.72	7.95	1.53	1.1	3.0	2.8	526	266	−639	+87	6.55	6.0
January ...	3,717	4,175	7.05	7.7	1.95	1.15	3.2	2.55	382	234	−346	+662	5.2	5.1
February ...	3,835	3,870	7.75	7.07	1.3	1.2	3.0	2.5	387	257	−200	+1,082	5.9	4.9
March ...	4,130	3,890	7.4	8.15	1.6	1.0	2.9	2.65	333	384	−557	+1,475	6.0	5.4
April ...	3,703	3,672	7.7	7.7	1.9	0.9	3.61	2.85	270	315	−91	+1,139	3.9	5.85
May ...	1,776	719	7.28	9.15	1.93	0.8	3.08	3.15	92	130	+22	+179	4.25	6.53

FIG. 5.—*Cost Comparisons.*

No.	Account.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.
1A	Vertical Retorts	373	446	319	299	352	395	436	376	374	415	391	369
1B	Total Gasification	60	29	18	42	45	57	63	83	58	76	73	54
2	Boilers	23	9	8	11	8	12	7	8	9	8	8	8
3	Generators	1	1	1	1	1	1	1	1	1	2	1	1
4	Conveyors	6	4	4	5	5	5	5	4	5	5	5	5
6	Purification	5	25	41	43	12	7	8	3	4	5	30	1
13	Mce. Mains	8	8	5	20	10	14	8	10	3	5	9	8
14	Mce. Meters	22	20	14	42	48	6	34	34	31	19	37	41
15	Mce. Cookers	33	11	7	3	6	6	6	11	9	5	5	5
1AM	V.R. Mce.	15	6	3	6	12	7	9	17	7	3	6	7
1BM	T.G. Mce.	4	3	4	4	5	2	1	2	1	12	3	4
2M	Boilers Mce.	3	10	10	2	4	9	13	6	1	11	3	15
3M	Generators Mce.	3	—	—	—	—	3	5	2	1	11	3	15
4M	Conveyors Mce.	16	2	30	5	7	7	16	40	20	6	7	18
12	Works Incosts	13	18	36	49	19	12	32	28	57	40	32	17

FIG. 6.—*Cost Account Comparisons.*

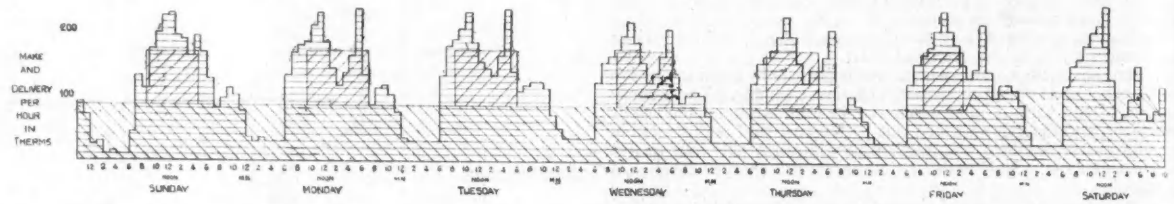


FIG 7

MAKE, DELIVERY AND OUTPUTS DURING A SPRING WEEK

DELIVERY TULLY MAKE VERTICAL RETORT MAKE

Tully plant, coals analyzed according to pits, coal into stock. From these sheets the gas make and coal and oil used are readily obtained.

Specimens of the Cost of Gas, fig. 4, and the Cost Analysis, fig. 3, are attached and are self-explanatory.

Two cost comparison sheets are in use and specimens are attached. Fig. 5 shows by-product income, costs of manufacture and distribution, and oncosts per therm with the progressive balance and comparison with the two previous years.

Fig. 6 shows a corresponding table for the principal cost accounts.

Part III.—Strategy and Tactics of Plant Operation.

The strategy and tactics of plant operation are too complicated to be easily described or summarized. There are not less than seven variables even when the plant is installed and therefore capital and other oncosts are largely fixed. The variables include the prices of coal, coke, oil, the demand for gas and coke, the freedom of supply of coal and oil. In a small works labour is fairly constant.

The plant at Renfrew Works may be operated to make 2,500 therms vertical retort gas and/or 2,200 therms C.W.G. or carburetted Tully gas. Before the decision was made as to the installation of Tully plant, continuous vertical retorts, or water gas plant, elaborate calculations were worked out on the prospective costs of gas-making on the various combinations. (It is perhaps humorous to recall that the range of coal prices used was 15s. to 35s. per ton.) It is not intended to go into the strategy of the selection of plant now, but rather to describe briefly the tactics employed under existing conditions.

Fig. 7 shows during a representative week in spring the gas delivered, the gas made in vertical retorts, the gas made in total gasification plant. Although the proportion of Tully gas to retort gas varies between *nil* and 50%, we have no effect on the gas quality visible to the consumer. The diagram shows how level stock in gasholders is kept by meeting the peak outputs with peak gas-making capacity.

The strategy of how much gas of each type is to be made depends on the factors involved in fig. 8. This figure is divided into two halves —one for an average summer output of 2,000 therms and one for a winter output of 3,000 therms. The top diagram in each case shows the weights of coal, coke, and oil involved in making the various mixtures in the case of the summer chart from *nil* to 1,000 therms Tully and in the winter from 1,000 to 2,000 Tully, with, in each case, the remainder of vertical gas. The tables have been drafted with coal constant in price and coke and oil variable, in order to simplify the diagrams below. The prices referred to are prices into the works for coal and oil and at works gate, *i.e.*, including lifting and rescreening in case of coke. No account is taken of capital or oncost charges nor of labour, since they are constant for practical purposes. Neither has tar, spent oxide, &c., been taken into account, since the variations in yields or prices are relatively small, and it is very easy, in this subject, to lose the main points in a mass of figures worked out to several decimal places.

In order to show the use of the bottom diagrams let us determine the cost per day in summer for materials using (1) all vertical retort gas, coal £2, coke £1.75.

This is the position 1 of the materials chart, and column 1 of the table. On the diagram the cost is given as £35 7s.—*i.e.*, the point on the dotted isovals corresponding to oil cost zero, coke cost £1.75.

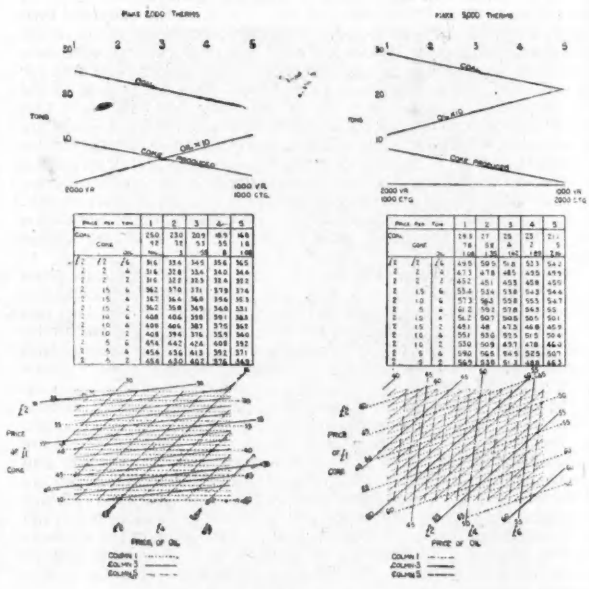


FIG 8.

Let us now determine the cheapest blend of gas when coal is £2, coke £1.75, oil £ *nil*—*i.e.*, on full subsidy.

From the diagram the point £2; 1.75 on the column 1 isovals is £38.1, on column 2 isovals £37.2, on column 3 isovals £29.5. The maximum make of Tully is therefore justified.

The following table shows the variation in cost of gas under winter conditions when coal is £2, coke £1.5, and oil price is varied:

	Nil.	£1.	£2.	£3.	£4.	£5.	£6.	£7.
Column 1 ...	46.0	47.5	49.1	50.1	51.2	52.3	53.4	55.5
,, 3 ...	45.3	46.6	48.0	49.3	50.7	52.0*	53.4*	54.7*
,, 5 ...	41.7*	43.9*	45.9*	48.0*	50.1*	52.3	54.4	56.5

It shows that under the conditions specified the cheapest gas is made with the maximum use of oil till oil is £4 per ton, then the 50% mixture is cheapest.

The output of coke under cheapest gas conditions would be half a ton per day till the price of oil rose to £4, when 4 tons per day would be made; the demand for coal would be 21 tons and 25 tons and for oil 2.16 tons and 1.62 tons.

PRODUCTS PRICES

The London Market Sept. 18.

A Government Order came into effect on March 1 controlling the price of Benzole and Coal Spirit and replacing the Control of Coal Tar Naphtha and Xylole Order, 1943.

The Order is known as the Control of Benzole and Coal Spirit Order, 1944 (S.R. & O. 1944, No. 172).*

By this Order the price of Motor Benzole is fixed at 2s. per gallon. The Order also lays down the method of evaluating Crude Benzole.

The Order also calls for periodical returns to the Ministry of Fuel and Power from all producers of Crude and Refined Benzole.

In connexion with the Coal Tar products market, the Government Order designated the Contol of Toluene (No. 4) Order, 1944 (S. R. & O. 1944, No. 170), contains an amendment of the Control of Toluene (No. 3) Order, 1943.

Attention is called to a new Government Order, which amends the price of Toluene as from Sept. 1, 1944. The Order is entitled, The Control of Benzole and Coal Spirit (No. 2) Order, 1944 (S. R. & O., No. 988).

The only change in connexion with the prices of Coal Tar Products refers to Naphthalene. A new Government Order, entitled the Coal Tar Products Prices (No. 2) Order, 1944 (S. R. & O. 1944, No. 1051), allows increases in the maximum prices for all forms of Naphthalene. The new Order comes into force on Sept. 22, 1944.

* Slightly amended by Control of Benzole and Coal Spirit (No. 2) Order, 1944, which amendments come into force on Oct. 1.

The Provinces Sept. 18.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 90's, 1s. 11d. to 2s. 1d., pure, 2s. 7½d. (controlled by the Control of Toluene No. 3 Order, dated July 14, 1943, operative from July 20, 1943). Benzole and Coal Spirit, also Coal Tar Naphtha and Xylole, are now controlled by the Control of Benzole and Coal Spirit Order, 1944, dated Feb. 18, 1944, S. R. & O. 1944, No. 172, operative from March 1. Carbolic acid, 60's, naphthalene, anthracene, creosote oil (hydrogenation), coal tar oils (timber preservation, &c.), and strained anthracene oil controlled by the Coal Tar Products Prices Order, 1943, dated Oct. 20, 1943 (S. R. & O. 1943, No. 1528), operative from Nov. 15, 1943.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

Scotland Sept. 16.

A steady throughput continues in the home market. Refined tar*: Yield to distillers is 4½d. per gallon *ex* Works, naked. Creosote oil: Timber preserving quality,* 5½d. to 6½d.; hydrogenation oil,* 5½d.; low gravity or virgin oil,† 7½d. to 7½d.; benzole absorbing oil,* 6½d. to 8d. per gallon. Refined cresylic acid* is 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha†: 6½d. to 7d. per gallon. Solvent naphtha*: Basic prices delivered in bulk, 90/160 grade, 2s. 8d., and 90/190 Heavy naphtha, Unrectified, 1s. 10½d.; Rectified, 2s. 2d. per gallon. Pyridine†: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

* Price controlled. † Uncontrolled.

[*We regret being unable to give our usual Stock Market Report this week.*]

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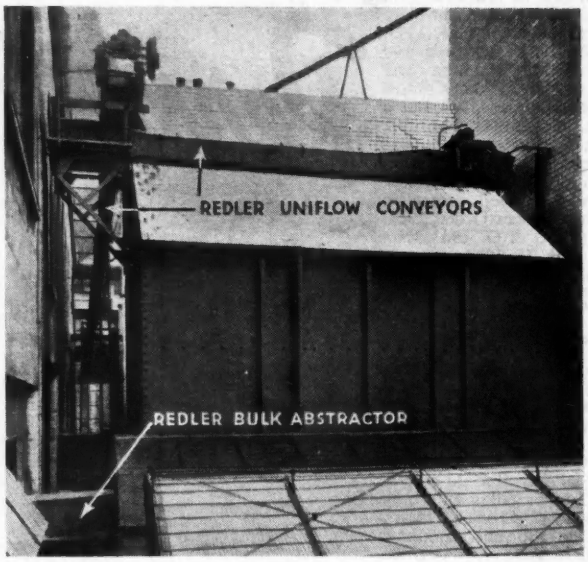

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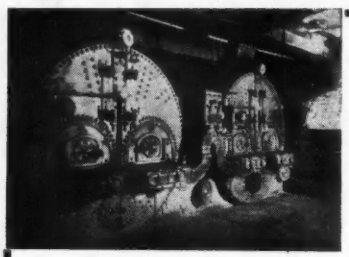

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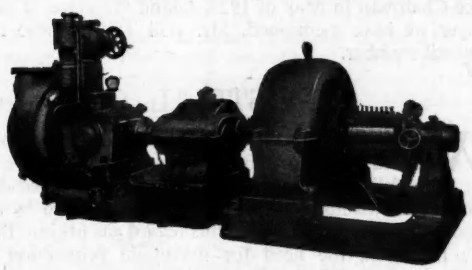

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